AD-A087 494 AIR FORCE INST OF TECH WRIGHT-PATTERSON AFB OH SCHOOL--ETC F/G 5/1
AN ANALYSIS OF FACTORS WHICH SHOULD BE CONSIDERED IN DEVELOPING--ETC(U)
JUN 80 T E FALCONER, D J MURPHY
UNCLASSIFIED AFIT-LSSR-11-80 NL

1 OF 2
AD A
087494

ADA087494

LEVEL

3

DTIC
ELECTE
AUG 5 1980
S D
D

DISTRIBUTION STATEMENT A
Approved for public release;
Distribution Unlimited

DEPARTMENT OF THE AIR FORCE
AIR UNIVERSITY (ATC)
AIR FORCE INSTITUTE OF TECHNOLOGY

Wright-Patterson Air Force Base, Ohio

DDC FILE COPY

80 8 4 019

Accession For	
NTIS GRA&I	☒
DDC TAB	☐
Unannounced	☐
Justification	
By	
Distribution/	
Availability Codes	
Dist. A	Avail and/or special

3

9 Master's thesis

6 AN ANALYSIS OF FACTORS WHICH SHOULD BE CONSIDERED IN DEVELOPING REPROCUREMENT DATA REQUIREMENTS

10 Thomas E. Falconer, Captain, USAF
David J. Murphy, Jr, Captain, USAF

11 Jun 80

14 AFIT-LSSR-11-80

12 144

USAF SCN 75-20B AFIT Control Number LSSR 11-80

AFIT RESEARCH ASSESSMENT

The purpose of this questionnaire is to determine the potential for current and future applications of AFIT thesis research. Please return completed questionnaires to: AFIT/ LSH (Thesis Feedback), Wright-Patterson AFB, Ohio 45433.

1. Did this research contribute to a current Air Force project?

   a. Yes b. No

2. Do you believe this research topic is significant enough that it would have been researched (or contracted) by your organization or another agency if AFIT had not researched it?

   a. Yes b. No

3. The benefits of AFIT research can often be expressed by the equivalent value that your agency received by virtue of AFIT performing the research. Can you estimate what this research would have cost if it had been accomplished under contract or if it had been done in-house in terms of man-power and/or dollars?

   a. Man-years ________ $ ________ (Contract).

   b. Man-years ________ $ ________ (In-house).

4. Often it is not possible to attach equivalent dollar values to research, although the results of the research may, in fact, be important. Whether or not you were able to establish an equivalent value for this research (3 above), what is your estimate of its significance?

   a. Highly Significant b. Significant c. Slightly Significant d. Of No Significance

5. Comments:

________________________ Name and Grade

________________________ Position

________________________ Organization

________________________ Location

OFFICIAL BUSINESS
PENALTY FOR PRIVATE USE. $300

NO POSTAGE
NECESSARY
IF MAILED
IN THE
UNITED STATES

BUSINESS REPLY MAIL
FIRST CLASS PERMIT NO. 73236 WASHINGTON D.C.

POSTAGE WILL BE PAID BY ADDRESSEE

AFIT/LSH (Thesis Feedback)
Wright-Patterson AFB OH 45433

UNCLASSIFIED

SECURITY CLASSIFICATION OF THIS PAGE (When Data Entered)

REPORT DOCUMENTATION PAGE

READ INSTRUCTIONS BEFORE COMPLETING FORM

1. REPORT NUMBER: LSSR 11-80
2. GOVT ACCESSION NO.: AD-A087494
3. RECIPIENT'S CATALOG NUMBER:
4. TITLE (and Subtitle): AN ANALYSIS OF FACTORS WHICH SHOULD BE CONSIDERED IN DEVELOPING REPROCUREMENT DATA REQUIREMENTS
5. TYPE OF REPORT & PERIOD COVERED: Master's Thesis
6. PERFORMING ORG. REPORT NUMBER:
7. AUTHOR(s):
   Thomas E. Falconer, Captain, USAF
   David J. Murphy, Jr., Captain, USAF
8. CONTRACT OR GRANT NUMBER(s):
9. PERFORMING ORGANIZATION NAME AND ADDRESS:
   Graduate Education Division
   School of Systems and Logistics
   Air Force Institute of Technology, WPAFB, OH
10. PROGRAM ELEMENT, PROJECT, TASK AREA & WORK UNIT NUMBERS:
11. CONTROLLING OFFICE NAME AND ADDRESS:
   Department of Communication and Humanities
   AFIT/LSH, WPAFB, OH 45433
12. REPORT DATE: June 1980
13. NUMBER OF PAGES: 87
14. MONITORING AGENCY NAME & ADDRESS (if different from Controlling Office):
15. SECURITY CLASS. (of this report): UNCLASSIFIED
15a. DECLASSIFICATION/DOWNGRADING SCHEDULE:
16. DISTRIBUTION STATEMENT (of this Report):
   APPROVED FOR PUBLIC RELEASE AFR 190-17.
   Fredric C. Lynch
   FREDRIC C. LYNCH, Major, USAF
   Director of Public Affairs
17. DISTRIBUTION STATEMENT (of the abstract entered in Block 20, if different from Report):
   Approved for public release; distribution unlimited
18. SUPPLEMENTARY NOTES:
19. KEY WORDS (Continue on reverse side if necessary and identify by block number):
   Procurement
   Contracting
   Reprocurement Data
   Data Acquisition
   Replenishment Spares
20. ABSTRACT (Continue on reverse side if necessary and identify by block number):
   Thesis Chairman: Darrell N. Fulton, Major, USAF

DD FORM 1 JAN 73 1473 EDITION OF 1 NOV 65 IS OBSOLETE

UNCLASSIFIED

SECURITY CLASSIFICATION OF THIS PAGE (When Data Entered)

The objectives of this research were to analyze whether the need for reprocurement data in weapon systems under development can be determined by the Annual Usage Rate (AUR) of items in existing weapon systems, and if the Item Category (defined as the first two digits of the Federal Stock Number), Item Price, and/or Actual Method of Procurement can be used to indicate AUR. Case analyses were conducted utilizing stratified random samples of items in the KC-135, F-4, and A-7 aircraft. Results of a previous C-130 case analysis were also used. Relationships between AUR and each variable were established. Tests were performed to determine if Item Categories experienced the same AUR on all weapon systems. Item Category was determined to be the most powerful indicator of AUR and the need for reprocurement data within similar types of weapon systems.

LSSR 11-80

AN ANALYSIS OF FACTORS WHICH SHOULD BE CONSIDERED IN DEVELOPING REPROCUREMENT DATA REQUIREMENTS

A Thesis

Presented to the Faculty of the School of Systems and Logistics

of the Air Force Institute of Technology

Air University

In Partial Fulfillment of the Requirements for the

Degree of Master of Science in Logistics Management

By

Thomas E. Falconer, BS
Captain, USAF

David J. Murphy, Jr., BBA, MS
Captain, USAF

June 1980

Approved for public release;
distribution unlimited

This thesis, written by

Captain Thomas E. Falconer

and

Captain David J. Murphy, Jr.

has been accepted by the undersigned on behalf of the faculty of the School of Systems and Logistics in partial fulfillment of the requirements for the degree of

MASTER OF SCIENCE IN LOGISTICS MANAGEMENT
(Captain Thomas E. Falconer)

MASTER OF SCIENCE IN LOGISTICS MANAGEMENT
(CONTRACTING AND ACQUISITION MANAGEMENT MAJOR)
(Captain David J. Murphy, Jr.)

DATE: 9 June 1980

Darrell N. Fulton

COMMITTEE CHAIRMAN

ACKNOWLEDGEMENTS

The completion of thesis research is a task not easily accomplished without the assistance, guidance, and support of many people. To all the people who have provided this to us, we owe our deep gratitude. A special thanks goes to our thesis advisor, Major Darrell N. Fulton, without whose expert assistance and insightful guidance this work could not have been accomplished.

This thesis is dedicated to our wives, Jan and Lucita, and our children, Jason, Eugene, Marcela, and Lucía. They have provided us the support and encouragement needed to successfully complete this program. They deserve special praise and recognition.

TABLE OF CONTENTS

PAGE

Chapter

LIST OF TABLES

CHAPTER I

INTRODUCTION

Statement of the Problem

To identify and reduce unnecessary expenditures for reprocurement data, a 1979 thesis by Johnson and Southwick reported evidence which indicates that the Annual Usage Rate (AUR) of an item is an accurate indicator of the need for reprocurement data. Their conclusion was based upon an analysis of items from the C-130 cargo aircraft. The analysis identified positive relationships between an item's Annual Usage Rate and its Item Category, Price, and Actual Method of Procurement (AMOP). While AUR, Item Category, Price, and AMOP are historical indicators of actual reprocurement data requirements, Item Category will be known earlier in the acquisition cycle for required items on a new weapon system. Johnson and Southwick recommended that general Item Categories with high Annual Usage Rates on existing weapon systems should be used to predict the reprocurement data requirements for similar weapon systems under development.

Before the recommendations of Johnson and Southwick can be implemented, further research is required to determine if the relationships identified by Johnson and

Southwick exist in other weapon systems, in order to validate the use of Annual Usage Rate as an indicator of future reprocurement data requirements. Of specific interest are KC-135 cargo-type aircraft, and the F-4 and A-7 fighter-type aircraft.

Justification

Each year, reprocurement data represents a substantial investment for the government, both in dollars and in the manpower and managerial talent required to supervise it. It is extremely costly to acquire, store, maintain, and disseminate this data. It is the government's policy to control both the extent and nature of data acquisition (31:p. 12:28). It has been estimated that the Department of Defense (DOD) spends $2 billion each year for technical data resulting in the purchase of six million separate pieces of data per year (23:253). As many as 600,000 pieces are sent to the Air Force Engineering Data Support Center (AFEDSC), usually referred to as the Data Repository (34). In fiscal year 1979, Air Force Logistics Command (AFLC) purchased over two billion dollars worth of replenishment spare parts. Of this amount, $426 million were spent competitively with the use of reprocurement data (26).

In spite of this high utilization, official guidelines to aid in determining what data to purchase have not been published. Existing regulations do not establish the data requirements for a contract (31:p. 9:29). As a result, it has been estimated that as little as 5 percent of the reprocurement data bought are actually ever used for the purchase of replenishment spare parts (13:2).

Control of the extent and nature of data acquired could provide for substantial cost savings to the government. Johnson and Southwick provided guidelines for use by Air Force managers in deciding whether to purchase reprocurement data (13:84). The guidelines were developed to help reduce the amounts of reprocurement data purchased, thereby reducing associated costs. Johnson and Southwick developed these guidelines by identifying the factors considered by Air Logistics Center Engineering Data Section personnel in deciding what data should be purchased. They also analyzed the characteristics of items on the C-130 aircraft which appeared to affect the need for replenishment items and spares during the time the item is in the active Air Force inventory.

Different types of aircraft operate in different environments; therefore, the support requirements may differ between aircraft types. Additionally, reprocurement data requirements may differ between different types of items. For example, the combat role of a fighter aircraft requires a lighter airframe to enable much higher speeds while at the same time withstanding the greater structural stresses encountered in combat maneuvers. Cargo aircraft are not subjected to structural stresses similar to those of a fighter. Component designs are typically much more complex in fighter aircraft, particularly in the avionics systems required of their combat missions. Consequently, before the guidelines developed by Johnson and Southwick can be utilized in a broad, general application, it must first be determined whether they are applicable to other cargo aircraft and to other types of systems that are purchased.

Definitions

It is important to understand what is included in reprocurement data. Data is defined as ". . . recorded information, regardless of form or characteristic [31:p. 9:53]." As a specific form of data, the Defense Acquisition Regulation (DAR) defines the next step, technical data, as "recorded information, regardless of form or characteristic, of a scientific or technical nature [31:p. 9:27]." Technical data includes research, development, or experimental work; may be utilized to define a design or a process; and may be utilized to purchase material. Technical data also refers to technical manuals used for component repair (31:p.1:19). Reprocurement data is a form of technical data.

The further delineation of reprocurement data is exhibited in the definition of "procurement data packages" as stated in MIL-STD-885B entitled Procurement Data Packages. A procurement data package is:

> . . . a generic term applicable to types of technical data when used for procurement purposes. It is a composite of specifications, plans, drawings, standards and such other data as may be necessary to describe existing material so they may be procured by the method contemplated [32:2].

Lieutenant Colonel Larry Schwartzman stated in his Air War College thesis, "Reprocurement Data Costs can be Reduced," that the term "reprocurement data" had never been defined in any official regulations. In spite of the change in the DAR from the term "procurement" to the terms "acquisition" and "contracting," the term "reprocurement data" will still be used in this thesis, since, as yet, an official definition for this or an equivalent term has not been published. For this thesis, Schwartzman's definition, which was also used by Johnson and Southwick, will be used:

> . . . Reprocurement data includes all data necessary to describe an existing item so that either an identical or interchangeable item can be procured on a competitive basis [21:11].

Purpose of Reprocurement Data

It is government policy that all acquisitions shall be made on a competitive basis to the maximum practicable extent (31:p. 1:21). Competition has broad socioeconomic merits. It is generally believed that competition leads to lower prices and the government policy of competition has historically led to substantial savings (8:1). General Accounting Office reports have shown savings of over 25 percent for competitive reprocurement after an item was originally purchased from the sole source manufacturer (12:1).

In order to utilize competition in the acquisition process, specifications which are explicitly clear to all parties involved are required (3:97). It is government policy to make technical data widely available "in order to obtain competition among its suppliers, and thus further economy in government procurement [31:p. 9:27]." Reprocurement data is used to accomplish the transfer of technology and thus gain the economic advantages of competitive reprocurement of spare parts (10:1,9).

Reprocurement Data Acquisition Process

A basic understanding of how reprocurement data are purchased will help clarify what reprocurement data are and how they are used.

The decision regarding the purchase of specific reprocurement data is made during the acquisition process (33:2). AFLC, the ultimate user of data for reprocurement of an item, establishes the requirement for reprocurement data. The Engineering Data Section personnel at each Air

Logistics Center have primary responsibility for the establishment of these requirements (24). AFLC conveys the requirement to the System Program Office (SPO), who in turn contracts for the needed data from the contractor. The contractor has the responsibility to prepare and provide the required technical data in the form of a reprocurement data package (9:8). As a result of this division of responsibility, it is essential that there be close interaction between the SPO, AFLC, and the user command during the acquisition process, to assure the acquisition of data required for proper logistics support throughout the life of the system (6:2).

The process of obtaining reprocurement data begins within the SPO at the beginning of the weapons acquisition cycle (13:5). A Program Manager should be appointed immediately after approval of the Mission Element Need Statement, which initiates the acquisition cycle (18:10).

Upon receipt of the Program Management Directive (PMD), the SPO begins to develop a Statement of Work containing preliminary data considerations. The Program Manager appoints a Data Management Officer who is responsible for directing all data management actions throughout the life of the program (29:2-5).

An initial action of the Data Management Officer is to issue a Data Call to all participating agencies. A Data Call is a formal procedure to acquire data requirements from all potential users, from any appropriate participating government agency (29:2). The users identify their requirements on a Contract Data Requirements List (DD Form 1423), selecting from DOD Authorized Data Lists or submitting unique requirements (21:35).

The Data Management Officer prescreens the requirements to consolidate requirements and eliminate duplications. The list is then screened to determine actual need by the Data Requirements Review Board, and is conducted in accordance with AFSCR 310-1 (13:5). This board is chaired by the Data Management Officer or the Program Manager.

The approved package of data items is then submitted to the Principal Contracting Officer for inclusion in the Request for Proposal, which communicates the government's requirements to industry. Each item of data is priced on the contractors' proposals, and these prices are evaluated as part of the source selection process. The final DD Form 1423 is then included in the resulting contract and becomes a firm requirement (21:36).

During this process the decision must be made as to which items of reprocurement data are to be purchased. To do this, the method by which each of the spares may be purchased needs to be known. To aid in this decision, the contractor is tasked to provide Contractor Recommended Codes (CRC), which represent the contractor's recommended method of contracting for spares throughout the life of the system (13:6). Each item will be assigned one of three codes (six, seven, or eight) in accordance with MIL-STD-789B, Procurement Methods Coding of Replenishment Spare Parts. For example, a code of CRC 6 indicates spares should be purchased through open competition and a code of CRC 7 indicates the contractor recommends that the spare part be purchased "only from selected source(s) for reasons indicated by the suffix code [33:3]." A suffix code indicates why the spares should not be purchased through open competition. MIL-STD-789B lists eleven such suffix codes. CRC 8 is the final code and indicates the spares should be obtained only from the prime contractor whenever the prime contractor is not the manufacturer. One of the eleven suffix codes is again assigned to indicate the justification for a sole source acquisition.

A team of government personnel from the Air Logistics Center with ultimate logistic responsibility for the system, is formed to review the CRCs (5). Their decision to accept the CRC or modify it results in the assignment of a Procurement Method Code (PMC) for each item (33:11). The PMC formalizes the specified manner in which an item will be reprocured. This process helps to determine which reprocurement data are required (13:8).

The responsibility for the acquisition of reprocurement data lies with the Program Manager and the Data Management Officer (13:8). Overall responsibility for data related actions shifts to the AFLC System or Item Manager once the program is transitioned from Air Force Systems Command (AFSC) to AFLC (25:p. 2-2).

The Administrative Contracting Officer accepts the data after it has been inspected, and the contractor submits it to the AFEDSC Repository located at Wright-Patterson AFB. The data are normally in the form of microfilm mounted on computer cards (5). AFEDSC receives over one-half million pieces of data each year (28:3). A copy of each piece of data is forwarded to the Air Logistics Center with Item Management responsibility for the item to which the data applies. At such time as additional spares are required, the data are removed from storage and used as specifications by the Air Logistics Center to competitively purchase the required spares (13:8-9).

Literature Review

The problems associated with competition and the reprocurement data acquisition process are by no means new. The General Accounting Office was studying the problems of competition as early as 1950 (20:11). Many people feel that the problems associated with reprocurement data are the key to most associated data issues (15). The issues of a competitive reprocurement are of concern to national leaders at the highest levels, receiving attention at least as high as the Assistant Secretary of Defense (Installations and Logistics) (19).

During the period of 1963 through 1965, several changes were implemented in the government regulations in order to improve data policy. These included revised rules for the determination of data rights, improved data standards, deferred ordering or delivery of data designed to reduce unnecessary purchases, and the coding and screening of parts to improve competitive procurement (7:39-43). But curiously enough, in spite of the high level recognition, little or nothing has been done since this time to improve the data acquisition process.

In accordance with Department of Defense policy, the Air Force must try to maximize the opportunity for competitive reprocurement in order to realize the potential cost savings. Many times this is not possible because the required technical data, prepared by the contractor, is either inadequate or unavailable. It also becomes more difficult to use competitive reprocurement as the item becomes more specialized and technologically advanced. Finally, there are economic, legal, and technological barriers to new firms entering the competitive process. Economic problems include the lack of funds for retooling and start up costs. Legal problems include the area of rights to data and the inability to acquire the necessary data. The transfer or communication of technological skills and techniques is also a difficult task, which if not accomplished will preclude a potential competitor from entering into competition (7:2-10).

Previous research has identified several problem areas in the existing reprocurement data acquisition process, which are all interdependent. First there exists a lack of consistency among the existing procedures and guidelines. This then tends to adversely affect the adequacy of the data purchased. As a result of the inadequate data received, the Air Force ultimately is forced to pay higher costs than should be expected (5).

Johnson and Southwick demonstrated that there is a lack of agreement in the Air Force over the adequacy of existing guidelines and procedures for acquiring technical data. There is even disagreement as to whether reprocurement data is useful or required. As previously stated, official guidelines have not been published to specify what data should be purchased, and no consistent procedures are followed by Engineering Data personnel when making this decision (13:86).

Much of the inconsistency has been attributed to the present difficulty in reading and understanding the current regulations which define procedures for data management (6:43). This results in vast differences in interpretation of what is really involved and required when purchasing and preparing reprocurement data.

Lack of consistency and guidance is one of the major reasons for the inadequate data that is often purchased. Many times the lack of satisfactory contractor prepared data has precluded competitive reprocurement, the manufacture of needed spares, or hampered the effective maintenance of a system (6:2). If a competitive contract for reprocurement of spares is awarded, and then it is discovered that there is inadequate data, added costs may be incurred or the contractor may be forced to manufacture and deliver unsatisfactory parts that do not adequately perform. Many times, when bidding on a competitive reprocurement, contractors do not examine the government supplied reprocurement data and it is not discovered until after contract award that the data are inadequate. This then results in added costs since the missing data may have to be generated again (5). It has been estimated that if all the data purchased each year had met its intended purpose and use, it would have resulted in $50 million more per year available for other purposes (6:3).

The legal, economic, and technological transfer difficulties, discussed above, that are experienced in competitive reprocurements often result in unplanned and undesirable modifications during production. These modifications adversely affect the cost, schedule, and technical parameters of the contract and tend to defeat the purpose of the acquisition (8:viii). Technological transfer is the task of communicating design and production technology to firms not engaged in the original research and development or previous production efforts. Some people feel that this communication is the key to purchasing adequate spare parts. There are cases where satisfactory spares were manufactured even without adequate reprocurement data after the defective data was pointed out to both the government Principal Contracting Officer and the contractor (8:98).

Many times after the required data have been delivered, entire pieces of data are found to be missing from the data package. This has proven to be one of the most glaring deficiencies found in reprocurement data (7:4). There are several reasons why contractors sometimes provide incomplete data. One is that many times portions of the data are claimed to be proprietary (data developed by the contractor at his own expense). Even if the data are not proprietary, many contractors are reluctant to deliver data containing technology, techniques, and know-how which they fear may be used against them in the future by competitors.

Contractors often claim proprietary rights on techniques or know-how developed under previous government contracts (9:4). Many of these claims involving proprietary rights do not meet the government definitions of proprietary rights, but go unchallenged due to the tedious, expensive and lengthy legal process associated with such a challenge. There usually is not time for this in the volatile environment of systems acquisition. Also, if a sufficiently long period of time elapses from the time the data is delivered to the time a deficiency is discovered, there is little recourse available to the government (6:6).

This leads to another claim that most of the inadequate reprocurement data can be attributed to shortcomings in the inspection and acceptance process (6:2). It has been estimated that less than 10 percent of government quality assurance personnel, who perform data acceptance inspections, have ever received any formal training for this portion of their jobs (7:89).

As the system of inspection and acceptance now functions, the data can only be spot checked. The contractor is the only one with the capability to check all of it (21:46). At the time of inspection and acceptance, the government is unable to make an accurate assessment as to the technical adequacy of the data. If the data are discovered to be deficient at the time of reprocurement, the government will have to return to the original manufacturer for production. In this case, all funds originally expended for reprocurement data for that item will have been wasted (7:82). The AFEDSC also duplicates much of the inspection that is performed, resulting in added inefficiencies and waste (7:89).

The degree of adequacy then is the major determinant in whether or not competition and its cost savings can be achieved in reprocurement. In the past, inadequate reprocurement data packages acquired by the Air Force have precluded many competitive reprocurements of replenishment spare parts. Of the $2.2 billion spent by AFLC in fiscal year 1979 for the purchase of replenishment spare parts, over $1.8 billion (81 percent) was spent noncompetitively (26). In the past as much as 67 percent of these noncompetitive buys have been attributed to the lack of adequate data (7:3).

Even with adequate reprocurement data, some unnecessary costs are realized. Drawings and specifications don't always provide access to technology sufficient to support competitive manufacturing (7:100). Even with complete reprocurement data, government engineers are reluctant to go to a source other than the original manufacturer due to poor results in the past (6:13).

Estimation and determination of reprocurement data costs is another huge problem. On the basic contract, reprocurement data is often included with all other data on the Contract Data Requirements List (DD Form 1423) and priced as a group. Then, too, there are differing opinions as to what is included in the cost of reprocurement data.

Does it include the engineering cost of generating the data or is it only the costs for reproduction and handling (10:20-21)? Contractors usually include only the costs for data preparation and reproduction. Thus the stated price rarely represents the real costs of the data, since these costs are probably inextricably mixed with the engineering costs (27:82). Until the terminologies and pricing guidelines are clearly defined, it will be impossible for the contractor to identify meaningful data acquisition costs.

It is also difficult to estimate ownership costs for the storage, update, dissemination, and disposal of government owned reprocurement data. AFEDSC does not maintain records on its operating costs (34). AFLC does not even maintain cost accounting records of the Repository at headquarters level (2).

Inconsistent usage of contract specifications for data also contribute to increased costs. For example, if MIL-STD-885B is incorporated into the contract and the exact form of the data is not specified, the contractor is required to provide it in Form 1, which is the most exacting and costly form of data. Close coordination between the contracting officer and the Air Logistics Centers is therefore required to ensure that the data is acquired in the most cost effective manner (10:34-41).

Many times engineering drawings can be used for more than one purpose. If so, the data may be called out for two different purposes and paid for twice. This adds unnecessarily to reprocurement data costs and there are many proven cases of such duplication of data between the services (21:45).

Besides the duplication of data purchased, the ownership costs are unnecessarily increased due to a duplication of records that are maintained. All records maintained at the Repository are also maintained at an Air Logistics Center. Very few people know what is available at the Repository. The system has been criticized by the General Accounting Office for violating principles of centralized data management (21:47-48).

Another concept which has contributed to the high cost of reprocurement is the overuse of competition. Many contracting personnel feel that the Air Force is sometimes overzealous in its efforts to obtain maximum competition and occasionally attempts are made to compete items when it does not "make sense" (7:80). It is DOD policy to acquire technical data rights which are essential to meet the government's needs (31:p.9:27). It is also DOD policy when acquiring spares to assure the requisite safe, dependable, and effective operations of the equipment. Reprocurement should be competitive so long as these requirements are not jeopardized. Otherwise reprocurement is to be made from the original manufacturer or other known source (31:p.1:31).

In light of these policies and the fact that many competitive reprocurements have failed or resulted in unsatisfactory spare parts, it is clear that the Air Force may be unwisely forcing competition into inappropriate situations. This results in the Air Force purchasing unnecessary reprocurement data and expending excess funds in doing so. The ultimate result of these problems is that the Air Force is wasting money by purchasing inadequate and unnecessary data, and there are no official guidelines to alleviate the problem.

Several people have attempted to develop techniques to reduce the problem. Captain F. H. LaMartin, Jr., USN, developed a technique utilizing decision theory and computer simulation which attempted to estimate the economic value of reprocurement data (14:1). In an attempt to develop standard pricing techniques, Mr. Vincent Mayolo from the Data Management Office of the Army Materiel Command did research to establish contractor manhours required for tasks normally performed when providing data to the government (30:7A1). Others have made recommendations for changes in Air Force policies and procedures. None of these suggested standards have been officially adopted.

One such suggestion is to reduce the amount of reprocurement data that are bought. The thesis by Johnson and Southwick was an attempt to establish guidelines for use by Air Force managers in determining whether to purchase reprocurement data. These guidelines could help to reduce the amount of procurement data that are purchased.

Johnson and Southwick established and reported the beliefs of Engineering Data personnel that reprocurement data can be useful and result in savings to the government. Engineering Data personnel have the prime responsibility for determining the need for reprocurement data. Seven factors were identified that are considered by these personnel when deciding which reprocurement data are required. The three most important factors are the design stability of the item, the cost of the item, and the expected life of the item in the inventory. It was determined that the item's annual usage rate should be the primary criterion for purchasing reprocurement data. For new systems, a projected annual usage rate can probably be estimated based upon past relationships of annual usage rates and item classification for similar weapon systems (13:84-89).

If it can be shown that the guidelines developed by Johnson and Southwick have a broader application than previously identified and if the amount of reprocurement data purchased can be effectively reduced, several of the previously identified problem areas may be alleviated or significantly reduced. For example, with less reprocurement data being received, the job of inspection and acceptance would be more manageable. Improved management could result in a higher quality of technical data on file in the Air Force data inventory. A higher quality of data would conceivably lead to increased utilization. A reduction in the amount of reprocurement data purchased would necessarily reduce associated costs. The acquisition and ownership costs associated with unnecessary purchases of reprocurement data would be eliminated. Furthermore, a reduction in the volume of data may improve the problem of data pricing and make it more manageable. Such improvements can be accomplished only if consistent guidelines are established to aid Air Force managers in their decision to purchase reprocurement data.

Research Objectives

The objectives of this research are:

1. To determine if the need for reprocurement data can be determined by the Annual Usage Rates of items in existing weapon systems.

2. To determine if Item Category, Item Price, and Actual Method of Procurement can be used as accurate indicators of Annual Usage Rate, thereby providing an early indication of reprocurement data requirements for weapon systems under development.

Research Questions

In order to accomplish the research objectives, the following research questions will be answered:

1. For each aircraft studied, is there a relationship between Annual Usage Rate and Item Category?

2. Do the same Item Categories on each weapon system have the same Annual Usage Rate?

3. For each aircraft studied, is there a relationship between Annual Usage Rate and Item Price?

4. For each aircraft studied, is there a relationship between Annual Usage Rate and Actual Method of Procurement (AMOP)?

5. Can the relationships between Annual Usage Rate and Item Category, Price, and AMOP on existing weapon systems be used to determine reprocurement data requirements for similar weapon systems under development?

CHAPTER II

METHODOLOGY

Overview

Data required to accomplish the research objectives were obtained through case analyses of three aircraft weapon systems. The case analyses were used to analyze the characteristics of a replenishment spare item which appeared to have a significant impact on the need for recurring acquisitions of the item during its active life on an aircraft system. The need for recurring acquisitions is indicative of the need for reprocurement data. The KC-135, F-4 and A-7 were selected for case analyses for this research. All three aircraft have been in the active Air Force inventory for a length of time sufficient to provide an adequate history of acquisitions. The relationships identified between Annual Usage Rate and Item Category, Price Per Item and AMOP, for each weapon system studied in this research were compared with those relationships identified by Johnson and Southwick. The results of these comparisons were used to determine if Annual Usage Rate can be used as a standard predictor for reprocurement data requirements for weapon systems under development.

Sampling Plan

Universe

The universe for this research consists of all replenishment spare parts for all aircraft in the active Air Force inventory.

Population

The population for this research consists of all Air Force managed replenishment spare parts for the KC-135, F-4 and A-7 aircraft.

Sample and Data Collection

Punched card decks containing all items on the KC-135, F-4 and A-7 aircraft were obtained from the Univac 1050-II Supply computer at three bases possessing those aircraft. A computer program developed at Seymour-Johnson Air Force Base and listed in Appendix A was utilized by each base to generate the data. Card decks of data were obtained from Grissom Air Force Base, Seymour-Johnson Air Force Base, and England Air Force Base for the KC-135, F-4, and A-7 respectively.

Common usage items managed by the Defense Logistics Agency, items coded as Time Compliance Technical Order (TCTO) kits, part numbered items, and new items with a temporary stock number were not considered due to the lack of available procurement history on these types of items.

Stratified random sampling was employed in the data collection required for this research. Stratified random sampling is most effective when handling a heterogeneous population with several homogeneous subgroups (1:129). The population studied is stratified within each aircraft according to the first two digits of the National Stock Number, known as the Item Category, and a simple random sample from each strata was obtained through the use of the procedure "SAMPLE," from the Statistical Package for the Social Sciences (SPSS) (16:128).

Determination of the sample size to be used requires that two basic factors be considered: (1) Is the sampling of attributes or of variables? and (2) What degree of accuracy and width of the interval estimate is required to satisfy the needs of the research? Sampling from a population of Item Categories requires the use of attribute sampling which concerns the proportion, (p), of the population which has a given attribute (4:150). The researchers require that with 95 percent confidence, the proportion of population parameter studied be within $\pm .08$ of the sample proportion obtained. Given the degree of accuracy and the interval estimate required, the standard error of the sample parameter can be computed as:

$$\sigma_p = \frac{\text{desired interval width}}{Z(1-\frac{\alpha}{2})} = \frac{.08}{1.96} = .0408$$

where,

σ_p = standard error of the sample parameter,

α = probability of selecting the alternate hypothesis when the null hypothesis is actually true. The level of α used was .05.

The standard error obtained is used to compute the minimum required sample size to obtain the accuracy desired (4:152).

$$N = \frac{p(1-p)}{\sigma_p^2} = \frac{.5(1-.5)}{.(0408)^2} = 150.0625 \approx 150$$

where,

N = Sample Size

P = Sample proportion (set at .5 to obtain maximum possible sample size)

σ_p = Standard error of the proportion for the sample (4:153).

Johnson and Southwick employed the same procedure cited above with one exception. Johnson and Southwick used a desired interval width of $\pm.1$ while this research used $\pm.08$. A decrease in the desired interval width was used to decrease the allowable standard error of the sample parameter, thereby increasing the accuracy of the results achieved.

Tables 1 and 2 present the Item Category frequencies for the population and for each generated sample. Appendix B provides a description of each Item Category.

For each of the items sampled, the Special Procurement History Extraction (AFLC Form J041.9ALA) was reviewed. The History Extraction is maintained for every item in the Air Force inventory and contains such information as the contractor, method of procurement used (see Table 3) and the date and quantity of each acquisition. The data obtained for this research were the quantity and price per item, per contract, and the Actual Method of Procurement used for the period 1 July 1972 to 1 October 1979.

Case Study Design

The KC-135, representing a cargo aircraft, was chosen to validate the relationships identified by Johnson and Southwick within similiar weapon systems. A validation within similar systems needs to be demonstrated before a comparative analysis between differing weapon systems can be attempted. A fighter and an attack aircraft were chosen because of the differences in the environments in which they operate as compared with cargo aircraft, and the desire of this research to test the

Table 1

POPULATION FREQUENCIES WITHIN ITEM CATEGORY

Item Cat.	KC-135	F-4	A-7
10	0	149	105
12	0	59	21
14	0	284	10
15	623	616	223
16	373	347	323
17	23	19	48
26	1	2	3
28	229	247	27
29	79	92	42
30	15	23	5
31	33	56	8
36	0	1	0
38	0	0	2
40	0	2	1
41	7	2	5
42	2	2	0
43	16	19	15
45	1	0	2
47	65	45	38
48	50	41	26
49	0	3	159
51	0	1	81
52	0	0	20
53	133	236	122
58	339	261	266
59	24	55	46
61	32	26	55
62	13	20	29
63	1	11	6
66	214	223	327
67	0	6	6
69	0	10	4
73	3	0	0
83	0	2	0
93	0	3	0
99	0	1	1
Totals	2,276	2,864	2,026

Table 2

SAMPLE FREQUENCIES WITHIN ITEM CATEGORY

Item Cat.	KC-135	F-4	A-7
10	0	8	11
12	0	1	2
14	0	17	0
15	38	41	14
16	30	16	26
17	3	3	3
26	0	1	0
28	24	14	1
29	4	3	3
30	1	1	0
31	2	4	0
43	1	0	0
47	4	0	4
48	3	3	1
49	0	0	14
51	0	0	5
52	0	0	1
53	9	15	6
58	17	16	21
59	0	2	3
61	3	1	5
62	1	1	4
63	0	1	1
66	12	12	23
67	0	0	1
69	0	1	0
99	0	0	1
Totals	152	161	150

TABLE 3

ACTUAL METHOD OF PROCUREMENT CODES

Code	Explanation
0*	This code is machine assigned when PMC is "00", in order to signify that the item is not reportable under AFR 57-6.
1	Current procurement is competitive, and the item was previously purchased competitively.
2	Current procurement is competitive, and the item is being purchased competitively for the first time.
3	Current procurement is noncompetitive from the actual manufacturer or a vendor, including a prime contractor who is the actual manufacturer.
4	Current procurement is noncompetitive, and the item is being purchased directly from the actual manufacturer or vendor for the first time rather than the original prime contractor for the end items for which the parts support.
5	Current procurement is noncompetitive, and the item is being purchased from a prime contractor who is not the actual manufacturer.

*Generally, this code is only assigned to items experiencing their first purchase. A code of "00" is usually assigned just once and allows the purchase to be processed through the J041 system.

SOURCE: (13:41).

relationships identified by Johnson and Southwick with weapon systems other than cargo aircraft.

Data Analysis Plan

The information utilized from the Special Procurement History Extraction included the total number of items acquired, the Price Per Item and the Actual Method of Procurement for the period 1 July 1972 to 1 October 1979. The Annual Usage Rate for each item was calculated as a ratio of the total quantities purchased divided by the total number of years covered by the History Extraction. For this research, Annual Usage Rate is considered to be the dependent variable while Item Category, Price and Actual Method of Procurement are independent variables. Since this research tested the relationship between the dependent variable and each independent variable, three separate tests were required for each weapon system. The methods used are consistent with those used by Johnson and Southwick. A second series of tests were required to test the correlation of relationships for the independent variable, Item Category, between weapon systems.

Measurement Level of the Data

Evaluation of the data collected revealed that Annual Usage Rate and Price Per Item are measured as ratio level data. Actual Method of Procurement is ordinal level data. Two degrees of competition are indicated. An AMOP of one or two indicates a competitive reprocurement while an AMOP of three, four, or five indicates a noncompetitive reprocurement. AMOPs of zero were not considered since they indicate the item is not reportable under AFR 57-6.

Statistical Tests--Within Weapon Systems

To test for the existence of a relationship between the dependent and independent variables for each aircraft, the level and nature of the data collected required the use of the three nonparametric measures of correlation: the Chi-Square Contingency Table, the Spearman Rank Correlation Coefficient and the Kendall Rank Correlation Coefficient.

The Chi-Square Contingency Table was used to test for the existence of a relationship between Annual Usage Rate and Item Category. The Chi-Square Contingency Table is appropriate when testing nominal level data (35:512).

The Spearman Rank Correlation Coefficient was used to test for the existence of a relationship between Annual Usage Rate and Price Per Item. Although both variables are ratio level data, when examining Price Per Item the assumption of a normally distributed population required for a parametric test could not be made by Johnson and Southwick. The rejection of this assumption in this research was based upon an examination of the Coefficient of Skewness for the Price Per Item obsevations, as discussed in Chapter III.

The Kendall Rank Correlation Coefficient was used to test for the existence of a relationship between Annual Usage Rate and AMOP. The Kendall Rank Correlation Coefficient is similar to the Spearman Rank Correlation Coefficient in that it compares ranking as opposed to actual values. Because of the large number of tied rankings encountered with AMOP, the Kendall Rank Correlation Coefficient is more appropriate than the Spearman Rank Correlation Coefficient because of its ability to handle such a situation (16:289).

Statistical Tests--Between Weapon Systems

Nonavailability of raw data from the Johnson and Southwick study prevents a detailed comparative analysis of findings. However, with the data generated by this research, a more in depth analysis of the relationships of the independent variables between weapon systems was undertaken. Of specific concern for this research was whether or not the same Item Categories have the same Annual Usage Rates between weapon systems. Item Categories common to at least two of the aircraft and with at least three sampled observances were tested. The requirement for at least three sampled observances is necessary to insure sufficient degrees of freedom to perform the required statistical test.

If the relationship between Annual Usage Rate and Item Category, Price Per Item, and AMOP are verified for all weapon systems studied, the validity of the use of Annual Usage Rate as a predictor of reprocurement data requirements for similar weapon systems under development will be set forth. The power of Annual Usage Rate as a predictor of reprocurement data requirements should be enhanced even further if the same Item Categories experience high Annual Usage Rates regardless of weapon system, since only Item Categories are known when developing the reprocurement data requirements for weapon systems under development.

The use of Analysis of Variance is appropriate for this comparison. Analysis of Variance (ANOVA) is "useful for studying the statistical relation between a dependent variable and one or more independent variables (17:522)."

Assumptions

The following assumptions were made in designing the methodology for this research:

1. The samples of acquisitions on the three weapon systems are representative of the population of all acquisitions of replenishment spare parts for these aircraft.

2. The computer program developed at Seymour-Johnson Air Force Base (Appendix A) provided an accurate listing of all Air Force managed replenishment spare parts for the three aircraft tested.

3. All acquisitions have been accurately recorded on the Special Procurement History Extraction.

4. The ownership of reprocurement data on items having a high Annual Usage Rate would be of greater economic value than ownership of reprocurement data on items experiencing a lower Annual Usage Rate.

Limitation

The following limitation applies to this research:

1. The inferences drawn from the case analyses are only directly applicable to the aircraft studied and the Air Force managed items studied.

CHAPTER III

CASE STUDIES DATA ANALYSIS

Overview

Actual testing and analysis of the data collected for the three aircraft is explained in this chapter using the methodology set forth in Chapter II.

Annual Usage Rate to Item Category

The Chi-Square test statistic was used to test for correlation between Annual Usage Rate and Item Category. The first step in testing for this correlation is the construction of a Chi-Square Contingency Table. The Chi-Square Contingency Table is a systematic method for displaying how two or more characteristics depend on each other by comparing the observed frequencies of an Item Category at specified levels of Annual Usage Rate to its expected frequencies (35:512). The expected frequency of any Item Category at a specified level of Annual Usage Rate is computed as follows:

$$f_e^i = \frac{c_i \; r_i}{N}$$

where,

f_e^i = expected frequency

c_i = total observed frequency for the respective column

r_i = total observed frequency for the respective row

N = sample size (16:223).

Comparisons of the observed frequency to the expected frequency allow the computation of the Chi-Square test statistic for independence as follows:

$$\chi^2 = \sum\sum\frac{(f_o^i-f_e^i)^2}{f_e^i}$$

where,

χ^2 = Chi-Square test statistic,

f_o = observed frequency,

f_e = expected frequency.

The standard SPSS program available on the CREATE computer calculates the Chi-Square test statistic. The Chi-Square test statistic is used to test the significance of the correlation between the two variables.

The computed Chi-Square statistic is compared with the known theoretical distribution of Chi-Square with [(r-1)(c-1)] degrees of freedom to test the following hypothesis:

H_o: There is no relationship between Annual Usage Rate and Item Category.

H_1: There is such a relationship.

$\alpha = .1$

A value of the test statistic larger than the value from the known theoretical distribution leads to a rejection of the null hypothesis.

Individual Chi-Square Contingency Tables constructed by the SPSS program for the test for each aircraft are presented in Tables 4a through 4c. Each cell of a table contains the observed frequency, the expected frequency, and each cell's contribution to the Chi-Square test statistic. The total computed Chi-Square test statistic is also shown.

One of the limitations of the Chi-Square Contingency Table is that when the degrees of freedom are greater than one, the table "should not be used when more than 20 percent of the expected frequencies are smaller than five or when any expected frequency is smaller than

Table 4a

KC-135 CHI-SQUARE CONTINGENCY TABLE

AUR	Item Category Group	15	16	17,28,29 30,31,43 47,53	48,58,61 62,66	Row Totals
0	f_o	7	7	8	18	40
	f_e	10.00	7.89	12.63	9.47	
	χ^2	.90	.10	1.70	7.68	10.38
0-20	f_o	11	6	4	6	27
	f_e	6.75	5.32	8.53	6.39	
	χ^2	2.68	.08	2.41	.02	5.19
20-100	f_o	9	5	9	5	28
	f_e	7.00	5.53	8.84	6.63	
	χ^2	.57	.05	.00	.4	1.02
100-500	f_o	8	7	17	4	36
	f_e	9.00	7.11	11.37	8.53	
	χ^2	.96	.00	2.79	2.41	5.31
Over 500	f_o	3	5	10	3	21
	f_e	5.23	4.14	6.63	4.97	
	χ^2	.96	.18	1.71	.78	3.63
Column Totals	f_o	38	30	48	36	152
	χ^2	5.22	.41	8.61	11.29	25.53

Table 4b

F-4 CHI-SQUARE CONTINGENCY TABLE

AUR	Item Category Group	15	28	29 58,66	10,12 14,16 17,26	30 31,38 53,59 61,62 63,69	Row Totals
0-30	f_o	15	2	20	19	5	61
	f_e	15.53	5.68	11.75	17.05	10.98	
	χ^2	.02	2.39	5.80	.22	3.26	11.69
30-100	f_o	8	2	7	3	6	26
	f_e	6.62	2.42	5.00	7.27	4.68	
	χ^2	.29	.07	.79	2.51	.37	4.03
100-500	f_o	13	3	2	10	7	35
	f_e	8.91	3.26	6.74	9.78	6.30	
	χ^2	1.87	.02	3.33	.00	.08	5.31
Over 500	f_o	5	8	2	13	11	39
	f_e	9.93	3.63	7.51	10.90	7.02	
	χ^2	2.45	5.25	4.04	.40	2.25	14.39
Column Totals	f_o	41	15	31	45	29	161
	χ^2	4.63	7.73	13.97	3.14	5.96	35.43

Table 4c

A-7 CHI-SQUARE CONTINGENCY TABLE

AUR	Item Category Group	10,12 15,17 28,29	16	49,51 52,53	58,47	48, 59,61 62,63 67,99	66	Row Totals
	f_o	4	8	9	12	2	8	43
0	f_e	9.75	7.45	7.45	7.17	4.59	6.59	
	χ^2	3.39	.04	.32	3.25	1.46	.30	8.77
	f_o	9	8	10	2	4	5	38
0-5	f_e	8.61	6.59	6.59	6.33	4.05	5.83	
	χ^2	.02	.30	1.77	2.96	.00	.12	5.17
	f_o	7	6	2	6	5	7	33
5-50	f_e	7.48	5.72	5.72	5.50	3.52	5.06	
	χ^2	.03	.01	2.42	.05	.62	.74	3.88
	f_o	14	4	5	5	5	3	36
50	f_e	8.16	6.24	6.24	6.00	3.84	5.52	
	χ^2	4.18	.80	.25	.17	.35	1.15	6.90
Column Totals	f_o	34	26	26	25	16	23	150
	χ^2	7.62	1.16	4.76	6.44	2.43	2.31	24.71

one [22:46]." The intervals for Annual Usage Rate and groups of Item Categories were established based on this requirement.

The test statistics for each test were compared with the critical value of χ^2. Results are summarized in Table 5. The critical value for each aircraft was determined as follows:

$$\chi^2[1 - \alpha; (r-1)(c-1)]$$

where,

c = Number of columns in the Chi-Square Table

r = Number of rows in the Chi-Square Table

$\alpha = .1$

The following decision rule was employed in this test.

if $\chi_{cal} \leq \chi^2[1-\alpha;\ (r-1)(c-1)]$; conclude H_o

if $\chi_{cal} > \chi^2[1-\alpha;\ (r-1)(c-1)]$; conclude H_1

For all three aircraft, the calculated Chi-Square test statistic was greater than its corresponding critical value. This led to a rejection of the null hypothesis in each case, providing statistical evidence of a relationship between Annual Usage Rate and Item Category.

Annual Usage Rate to Price Per Item

The Spearman Rank Correlation Coefficient was used to test for the existence of a relationship between

Table 5

CHI-SQUARE TEST RESULTS

KC-135

$\chi^2 (.90;\ 12) = 18.55$ χ^2 test statistic = 25.53

25.53 > 18.55

Therefore, there is statistical evidence of a relationship between Annual Usage Rate and Item Category.

F-4

$\chi^2 (.90;\ 12) = 18.55$ χ^2 test statistic = 35.43

35.43 > 18.55

Therefore, there is statistical evidence of a relationship between Annual Usage Rate and Item Category.

A-7

$\chi^2 (.90;\ 15) = 22.31$ χ^2 test statistic = 24.71

24.71 > 22.31

Therefore, there is statistical evidence of a relationship between Annual Usage Rate and Item Category.

Annual Usage Rate and Price Per Item. This test was used since the assumption of a normally distributed population could not be accepted. Because of this a parametric statistical test could not be utilized. The rejection of this assumption in this research was based on an examination of the Coefficient of Skewness for the Price Per Item observations. The Coefficient of Skewness is based upon the spread between the arithmetic mean and the median of the distribution in question, and is calculated as follows:

$$SK = \frac{3(x - MD)}{s}$$

where,

SK = Coefficient of Skewness,

x = Sample mean,

MD = Sample median,

s = Standard deviation.

The Coefficient of Skewness must equal zero for a symmetrical or normally distributed population (17:66). The SPSS Condescriptive Statistics option was utilized to compute this coefficient. The results are summarized for each aircraft in Table 6.

As can be seen from Table 6, the Coefficient of Skewness computed for each aircraft does not equal zero. The assumption of a normally distributed population, required for a parametric test, could not be made. The Spearman Rank Correlation Coefficient is therefore appropriate to test for a relationship between Annual Usage Rate and Price Per Item.

Table 6

COEFFICIENT OF SKEWNESS

KC-135	7.573
F-4	4.242
A-7	2.388

The Spearman Rank Correlation Coefficient requires the use of rankings of the values for a particular variable rather than their absolute values. The Spearman Rank Correlation Coefficient, r_s, compares the sum of the squared differences in the paired ranks for two variables over all cases divided by a computed quantity of what the sum of the squared differences would have been if the two sets of rankings had been totally independent (16:289). The Standard SPSS program available on CREATE was used to compute the Spearman Rank Correlation Coefficient. According to Siegel, if the sample size is greater than ten, the test statistic computed using r_s is distributed as t(N-2) when employed in the following formula:

$$t^* = r_s\sqrt{\frac{N-2}{1-r_s^2}}$$

where,

t^* = Student's t statistic,

r_s = Spearman Rank Correlation Coefficient,

N = Sample size. (22:212)

The significance of r_s was tested at $\alpha = .1$ against the following hypothesis:

H_o: There is no relationship between Annual Usage Rate and Price Per Item.

H_1: There is such a relationship.

The computed value, t^*, was compared with the value of the known theoretical distribution of $t(1-\frac{\alpha}{2};n-2)$.

The correlation coefficient, r_s, can take on a value from -1 to 1, with the sign of the coefficient indicating the direction of the relationship. A two-tailed test is appropriate with the following decision rule:

If $t^* > t(1-\frac{\alpha}{2};\ n-2)$ or

$t^* < t(\frac{\alpha}{2};\ n-2)$

Reject the null hypothesis.

The results of the Spearman Rank Correlation Coefficient tests, as computed by SPSS, are shown in

Table 7. In each case, the computed value of r_s was used to compute t*. For all aircraft, t* was less than the critical value of $-t(1-\frac{\alpha}{2};n-2)$. As a result, the null hypothesis is rejected and it can be concluded that there is a relationship between Annual Usage Rate and Price Per Item. The negative values of r_s and t* indicate that there is a negative correlation betwen AUR and Price Per Item which means that Annual Usage Rate will tend to be higher when the Price Per Item is low.

Annual Usage Rate to Actual Method of Procurement (AMOP)

The Kendall Rank Correlation Coefficient was used to test for existence of a relationship between Annual Usage Rate and AMOP. Before the Kendall Rank Correlation Coefficient test could be performed, it was necessary to determine a single AMOP to represent each item. For each item in the sample, the Special Procurement History Extraction was used to determine a single AMOP to represent the item over the history of purchases. It was discovered that many of the items in the sample had been purchased using several different AMOPs. Because of the ordinal level of the data, the median AMOP was chosen as most representative. To determine the median AMOP, the midpoint of the total quantity of units purchased was computed. Each purchase for an item was then listed in

Table 7

SPEARMAN RANK CORRELATION COEFFICIENTS
ANNUAL USAGE RATE WITH PRICE

AIRCRAFT	r_s	N of CASES[+]	t^*	DECISION RULE TEST[++]	RESULTS
KC-135	-.4138	152	-5.567	-5.567 < -1.645	REJECT H_O AN INVERSE RELATIONSHIP EXISTS
F-4	-.6333	161	-10.319	-10.319 < -1.645	REJECT H_O AN INVERSE RELATIONSHIP EXISTS
A-7	-.4538	147	-6.132	-6.132 < -1.645	REJECT H_O AN INVERSE RELATIONSHIP EXISTS

\+ N OF CASES: SAMPLES ITEMS WITH NO PRICE AVAILABLE WERE OMITTED.

++ $t_{critical} = -t(.95; N-2)$. IN ALL CASES: $-t_{critical} = -1.645$

chronological sequence. The median AMOP for an item was determined to be the AMOP corresponding to the purchase in which the median of the units purchased was made.

According to Siegel, when sample size is greater than ten, the test statistic computed using the Kendall Rank Correlation Coefficient (TAU C) is normally distributed when employed in the following formula:

$$Z^* = \frac{\text{TAU C}}{\sqrt{\frac{2(2N+5)}{9N(N-1)}}}$$

where,

Z^* = Kendall standard normal variable value,

N = Sample size,

TAU C = Kendall Rank Correlation Coefficient (22:520-522).

The significance of TAU C was tested at $\alpha = .1$ against the following hypothesis:

H_o: There is no relationship between Annual Usage Rate and AMOP.

H_1: There is such a relationship.

As with the Spearman Rank Correlation Coefficient, Kendall's TAU C can also take on a + or - value, again indicating the direction of the relationship. The computed value of Z^* was compared with the value of Z from the theoretical normal distribution at $\pm Z(1-\frac{\alpha}{2})$. A value of Z^* less than $-Z(.95)$ or greater than $Z(.95)$ leads to a rejection of the null hypothesis.

The results of the Kendall Rank Correlation Coefficient tests are shown in Table 8. Each value of TAU C, as computed by SPSS, was used to compute the test statistic Z^*, which was then compared to the critical value of $-Z(.95)=-1.645$. In each case Z^* was less than -1.645 and the null hypothesis was rejected.

For each aircraft, the results indicated with 90 percent confidence that there is a relationship between Annual Usage Rate and Actual Method of Procurement. The test also indicates a negative correlation. This shows that the higher the Annual Usage Rate is, the lower is the AMOP. The lower AMOP indicates a competitive purchase. As a result, the larger the quantities of an item that have been purchased and the higher its Annual Usage Rate, the more likely it is that the item was purchased through competitive means. Reprocurement data would then be required for these items.

Statistical Tests Between Weapon Systems

Analysis of Variance was used to determine whether or not Item Categories have the same Annual Usage Rates between weapon systems.

Table 8

KENDALL RANK CORRELATION COEFFICIENTS
ANNUAL USAGE RATE WITH AMOP

AIRCRAFT	TAU C	N of CASES	Z^*	DECISION RULE TEST++	RESULTS
KC-135	-.4578	152	-8.370	$-8.370 < -1.645$	REJECT H_O AN INVERSE RELATIONSHIP EXISTS
F-4	-.4261	161	-8.160	$-8.150 < -1.645$	REJECT H_O AN INVERSE RELATIONSHIP EXISTS
A-7	-.5365	150	-9.742	$-9.742 < -1.645$	REJECT H_O AN INVERSE RELATIONSHIP EXISTS

++ Z^* compared against $-Z(.95) = -1.645$ in all cases

ANOVA is a special case of linear regression but with two basic distinctions:

1. While the regression model assumes a response curve and relates the means of the probability distribution of Y (the dependent variable) to the levels of the independent variable X, ANOVA makes no such assumption; and

2. From the response curve, regression would allow prediction of a number of outcomes for intermediate levels of X. ANOVA makes no such response prediction and only provides information about the specific levels studied (17:525). ANOVA deals with factors (independent variables) and treatments (particular outcomes of the independent variable). For this research the factors involved were be the Item Categories in the sample and the treatments were the Annual Usage Rate achieved by each weapon system for that Item Category. The hypotheses tested were:

H_o $\mu_1 = \mu_2 = \mu_3$

H_1: Not all μs are equal

where,

μ = Mean Annual Usage Rate for the Item Category considered for each weapon system.

Neter, Wasserman and Whitmore state that the appropriate test statistic is:

$$F^* = \frac{MSTR}{MSE}$$

where,

MSTR = Regression treatment mean square

MSE = Error mean square (17:533).

The significance of the values of F^* were tested at α=.1 and compared with the value of the theoretical distribution of

$$F(1-\alpha;\ r-1,\ n_t-r)$$

where,

r = Number of factors

n_t = Total number of observations.

A value of F^* greater than $F(1 - \alpha;\ r-1,\ n_t - r)$ leads to a rejection of the null hypothesis.

The fifteen sampled Item Categories which are common to at least two of the aircraft and had at least three sampled observances were tested with ANOVA. The requirement for at least three sampled observances was necessary to provide sufficient degrees of freedom to calculate the critical value from the F distribution.

The ANOVA program of SPSS was utilized to calculate value of F* for each Item Category tested. This value was then compared with the appropriate value of $F(1-\alpha; r-1, n_t - r)$ to test for the equality of means. The results of this test are summarized in Table 9.

In the tests on Item Categories 53 and 62, the null hypothesis was rejected. It can be stated with a confidence of 90 percent that the mean Annual Usage Rates for these items are not equal among the three aircraft studied. In the tests on the other thirteen Item Categories, there was insufficient evidence to reject the null hypothesis.

Table 9

ANALYSIS OF VARIANCE

Item Cat.	n_t	r	$F(1-\alpha; r-1; n_t-r)$	F*	Test
10	19	2	3.03	0.210	$0.210 < 3.03$; Conclude H_o
12	3	2	39.86	0.533	$0.533 < 39.86$; Conclude H_o
15	93	3	2.39	1.228	$1.228 < 2.39$; Conclude H_o
16	72	3	2.39	0.768	$0.768 < 2.39$; Conclude H_o
17	9	3	3.46	3.396	$3.396 < 3.46$; Conclude H_o
28	39	3	2.49	0.272	$0.272 < 2.49$; Conclude H_o
29	10	3	3.26	0.940	$0.940 < 3.26$; Conclude H_o
31	6	2	4.54	0.412	$0.412 < 4.54$; Conclude H_o
47	8	2	3.78	1.487	$1.487 < 3.78$; Conclude H_o
48	7	3	4.32	0.231	$0.231 < 4.32$; Conclude H_o
53	30	3	2.51	5.576	$5.576 > 2.51$; Conclude H_1
58	54	3	2.44	0.729	$0.729 < 2.44$; Conclude H_o
61	9	3	3.46	2.707	$2.707 < 3.46$; Conclude H_o
62	6	3	5.46	41.964	$41.964 > 5.46$; Conclude H_1
66	47	3	2.44	2.187	$2.187 < 2.44$; Conclude H_o

CHAPTER IV

CONCLUSIONS AND RECOMMENDATIONS

Overview

The objective of this research was to determine if the variables Item Category, Price and Actual Method of Procurement can be used to indicate the Annual Usage Rate of a replenishment spare part and thus the requirement to purchase reprocurement data. This chapter presents the conclusions drawn from this study and recommendations for improvements to the current methods of acquiring and managing data. Finally, recommendations for further research are presented.

Conclusions

Research Question 1

For each aircraft studied, is there a relationship between Annual Usage Rate and Item Category?

The thesis by Johnson and Southwick showed that there was a relationship between Annual Usage Rate and Item Category on the C-130 aircraft. This research showed through the use of the Chi-Square Contingency Table that a similar relationship exists in the KC-135, the A-7, and the F-4 aircraft. Since Annual Usage Rate is related to the Item Category, reprocurement data would tend to be required for those Item Categories that experience a higher Annual Usage Rate.

Research Question 2

For each aircraft studied, is there a relationship between Annual Usage Rate and Item Price?

The Spearman Rank Correlation Coefficient indicated that there is a relationship between Annual Usage Rate and Item Price for the KC-135, A-7, and F-4 aircraft. The negative correlation established that lower priced items tend to have a higher Annual Usage Rate. The same relationship has previously been demonstrated on the C-130 aircraft. Since the lower priced items tended to be purchased in larger quantities and on a recurring basis, the need for reprocurement data on these items is indicated by the Item Price.

Research Question 3

For each aicraft studied, is there a relationship between Annual Usage Rate and Actual Method of Procurement (AMOP)?

The Kendall Rank Correlation Coefficient indicated that there is a relationship between Annual Usage Rate and AMOP for all three airacraft. As was the case for the C-130 case study performed by Johnson and Southwick, the negative correlation established that items with a high AUR tend to be purchased competitively. Since reprocurement data is required for any item that is reprocured competitively, the correlation also supports the assumption that AUR is an indicator of the need for reprocurement data.

Research Question 4

Do the same Item Categories on each weapon system have the same Annual Usage Rates?

Analysis of variance (ANOVA) was performed in an attempt to further validate the use of Item Category as a predictor of an item's Annual Usage Rate (AUR) across differing weapons systems. Results were inconclusive. For two Item Categories, it was possible to conclude that the AUR is not the same between weapons systems. For the remaining thirteen Item Categories tested, statistical evidence was not sufficient to draw such a conclusion. Because of the existence of both equal and unequal mean AURs, the ANOVA test has shown that without further testing, Item Category cannot be used to predict AUR, irregardless of weapon system. Based upon this research it would be inappropriate to attempt to predict the AUR of an item on a bomber-type aircraft by using the AUR experienced for a similar item on a fighter-type aircraft.

It would also be inappropriate to use an Item Category not tested in this research.

Research Question 5

Can the relationship between Annual Usage Rate and Item Category, Price, and AMOP on existing weapon systems be used to determine reprocurement data requirements for similar weapon systems under development?

The statistical tests performed show that the variables tested were indicative of the AUR of an item. The Spearman Rank Correlation Coefficient showed that lower priced items tend to have a higher AUR. The Kendall Rank Correlation Coefficient indicated that items to be reprocured competitively tended to have a higher AUR. AUR is also influenced by the Item Category, or type of item being used. Of the three variables, Item Category provides the earliest, and therefore most valuable, indication of AUR and the need for reprocurement data.

The usefulness of the three variables as indicators of reprocurement data requirements is based on two assumptions. The first assumption is that AUR does in fact indicate the need for reprocurement data. Evidence seems to support this assumption. Reprocurement data is required for any item that is reprocured competitively. The Kendall Rank Correlation Coefficient established that items with a high AUR will tend to be reprocured competitively, thereby requiring reprocurement data. The Spearman Rank Correlation Coefficient showed that lower priced items tend to be reprocured in large quantities on a recurring basis (high AUR), also requiring reprocurement data.

The second assumption is that these same relationships will hold true in future weapon systems. If these assumptions are verified, the usefulness of Item Category in determining data requirements would be greatly enhanced.

The use of Item Category as an indicator of reprocurement data requirements should be limited at this time to the indication of reprocurement data requirements in similar types of weapon systems, where the item would be utilized under similar conditions. As previously stated, the AUR of an Item Category on a fighter-type aircraft may not be the same as that Item Category's AUR on a bomber-type aircraft.

Summary of Conclusions

The answers to the five research questions resulted in two basic conclusions:

1. The Chi-Square, Spearman, and Kendall tests demonstrated the validity of the Item Category, Price, and AMOP as accurate indicators of Annual Usage Rate on existing weapon systems. The relationships identified

also validate the results of Johnson and Southwick. Based upon the results of this research and those of Johnson and Southwick, it is believed that reprocurement data requirements for proposed weapon systems can be more accurately identified through knowledge of the Annual Usage Rates of similar items on existing similar weapon systems. Similarity of items can be determined by Item Price, AMOP, or Item Category.

2. The ANOVA test required the conclusion that the AURs for some Item Categories are equal in each aircraft studied and the AURs for other Item Categories are not equal in each aircraft studied. The researchers believe, therefore, that generalized statements about the level of AURs for all aircraft, based upon the AURs of any single aircraft, are not appropriate at this time.

Recommendations

Need for Policy Guidelines

It was learned during this research that many Air Force managers are uncertain or even confused as to their duties and responsibilities concerning reprocurement data. Firm policy and specific guidance should be developed, particularly guidelines to aid Air Force managers in determining whether or not reprocurement data is required.

Centralization of Responsibility

Although AFSC purchases the majority of reprocurement data, AFLC is the primary user of that data. A feasibility study into the possibility of placing acquisition and management responsibility under one organization is advisable. Single responsibility could help to eliminate much of the ambiguous and conflicting guidance that does exist.

Quality Control

This research pointed out the belief that much of the data received by the Air Force is of such poor quality that they can never be used for their intended purposes. An in-depth study should be performed to reveal the facts concerning the quality of Air Force data and recommend methods of improving the quality of data received. A system should also be instituted to provide exact information on what data is contained in the Data Repository. This information could be utilized to preclude the purchases of data already contained in the Air Force inventory.

Proprietary Rights

It was observed in this research that many times, claims by the contractors of proprietary rights can prevent the government from using data to competitively reprocure items. There is need to determine whether the government should challenge these claims more strongly and consistently.

Data Costs

Data on the costs associated with ownership of reprocurement data is not currently available. It is presently impossible to assess the economic benefits of owning reprocurement data or the benefits to be derived from revising current methods of data acquisition. The government needs to establish a system for accumulating the costs of owning all data, particularly reprocurement data.

Further Case Analysis Research

This research further substantiated relationships identified in a previous study on reprocurement data. The same types of relationships appear to exist in both cargo-type and fighter-type aircraft. This research should be replicated on other aircraft and weapon systems, to further substantiate the relationships identified and lead toward the establishment of specific guidelines to aid in determining reprocurement data requirements for all types of weapon systems entering the Air Force inventory.

Further tests should also be performed to determine the exact characteristics of the relationship between Item Category and Annual Usage Rate. These tests should attempt to develop more conclusive evidence and information regarding the relationship between Item Category and AUR among different types of weapon systems and within similar types of weapon systems. This would aid in the development of more precise guidelines regarding the determination of reprocurement data requirements.

APPENDIXES

APPENDIX A

DATA GENERATION COMPUTER PROGRAM

```
UTØ8T SRD TAPE SCAN
LIST FINAL
FILE ON TAPE
CONSTANTS
ACXAEH         168   15   Ø1415      AJ9   XJE AGH
NO ITEM RECORD FOR THIS STOCK NUMBER
INVALID LABEL  L3WSU
SUBROUTINE A
               RZSTK7Ø3Ø   RDIAS     TØ1
*A1            C7Ø32TØ2ØE16JUMP  *A3   CIØ6ØT167EØ4JUMP *A2    RDIAST167TØ1
               JUMP *A1
&A2            XBØ36ØØ36Ø36X7ØØ3ØØ6ØØ15PRINT       JUMP *A4
*A3            C 'F'TØ34U   JUMP *A4
               XTØ186Ø15Ø15XTØ716Ø35Ø19XTØ366Ø39ØØ3X7Ø356Ø43ØØ3XTØ3Ø6Ø52ØØ8
               WRITE       X '1'HØØ1
*A4            EXIT
PROGRAM
*ØØ            XAØØ9AØ11ØØ2                        XAØ23AØ25ØØ2X ']'X2Ø9
               WRITE OPEN XX115X236ØØ4
*Ø1            TAPE READ  CCØ177ØØ1UØ2JUMP *Ø2     CCØ2Ø7Ø16UØ3JUMP *Ø2
               TAØ19X245B32
               X '+'X246   JUMP *Ø3
*Ø2            TYPE CØØ1 13TYPE 7ØØØ 23HALT *Ø1
*Ø3            TAPE READX C7Ø3ØDØ15515JUMP  *Ø8    X7Ø3ØDØ15Ø15
               C 'F'7ØØØE  JUMP *Ø8    C 'R'7ØØØE  JUMP *Ø8
               JUMP *Ø8 3
*Ø5            C ' '7031E  JUMP *Ø7    C 'Ø'7031U  JUMP *Ø6    CAØØ37Ø35EØ3
               PERFORM A   CAØØ67Ø35EØ3PERFORM A   CAØ4Ø7Ø35EØ3PERFORM A
               CAØ457Ø35EØ3PERFORM A   CAØ497Ø35EØ3PERFORM A   CAØ547Ø35EØ3
               PERFORM A   CAØ597Ø35EØ3PERFORM A   CAØ637Ø35EØ3PERFORM A
*Ø6            X71837172142
               JL *Ø5 AØ11
*Ø7            XAØØ9AØ11ØØ2JL *Ø3 AØ25 XAØ23AØ25ØØ2JUMP *Ø3
*Ø8                                                TAØ28ZØØ2B32TAØ3ØZØØ3B21
               WRITE CLOSE TAPE CLOSE
```

```
              SORT         C ']'X241U  END OF JOB  READ OPEN
Ø9            READ *1Ø     C5Ø152Ø;5E;5JUMP *Ø9     X5Ø8Ø2Ø8ØØ8ØPUNCH
              JUMP *Ø9
*1Ø           END OF JOB
START *ØØ
```

APPENDIX B

ITEM CATEGORY DESCRIPTIONS

10GP	Weapons
11GP	Nuclear ordnance
12GP	Fire control equipment
13GP	Ammunition and explosives
14GP	Guided missiles
15GP	Aircraft, and airframe structural components
16GP	Aircraft components and accessories
17GP	Aircraft launching, landing and ground handling equipment
18GP	Space vehicles
19GP	Ships, small craft, pontoons, and floating docks
20GP	Ship and marine equipment
22GP	Railway equipment
23GP	Motor vehicles, trailers and cycles
24GP	Tractors
25GP	Vehicular equipment components
26GP	Tires and tubes
28GP	Engines, turbines, and components
29GP	Engine accessories
30GP	Mechanical power transmission equipment
31GP	Bearings
32GP	Woodworking machinery and equipment
34GP	Metalworking machinery
35GP	Service and trade equipment
36GP	Special industry machinery

37GP	Agricultural machinery and equipment
38GP	Construction, mining, excavating and highway maintenance equipment
39GP	Materials handling equipment
40GP	Rope, cable, chain, and fittings
41GP	Refrigeration, air conditioning, and air circulation equipment
42GP	Fire fighting, rescue, and safety equipment
43GP	Pumps and compressors
44GP	Furnace, steam plant, and drying equipment, and nuclear reactors
45GP	Plumbing, heating, and sanitation equipment
46GP	Water purification and sewage treatment equipment
47GP	Pipe, tubing, hose, and fittings
48GP	Valves
49GP	Maintenance and repair shop equipment
51GP	Hand tools
52GP	Measuring tools
53GP	Hardware and abrasives
54GP	Prefabricated structures and scaffolding
55GP	Lumber, millwork, plywood, and veneer
56GP	Construction and building materials
58GP	Communication, detection, and coherent radiation equipment
59GP	Electrical and electronic equipment components
61GP	Electric wire, and power and distribution equipment

62GP	Lighting fixtures and lamps
63GP	Alarm and signal systems
65GP	Medical, dental, and veterinary equipment and supplies
66GP	Instruments and laboratory equipment
67GP	Photographic equipment
68GP	Chemicals and chemical products
69GP	Training aids and devices
70GP	General purpose ADPE, software, supplies and support equipment
71GP	Furniture
72GP	Household and commercial furnishing and appliances
73GP	Food preparation and serving equipment
74GP	Office machines, visible record and data procession equipment
75GP	Office supplies and services
76GP	Books, maps, and other publications
77GP	Musical instruments, phonographs, radios, home type
78GP	Recreational and athletic equipment
79GP	Cleaning equipment and supplies
80GP	Brushes, paints, sealers, and adhesives
81GP	Containers, packaging, and packing supplies
83GP	Textiles, leathers, furs, shoe fittings, tents, flags
84GP	Clothing, individual equipment, and insignia
85GP	Toiletries

87GP	Agricultural supplies
88GP	Live animals
89GP	Subsistence
91GP	Fuels, lubricants and waxes

APPENDIX C

RESEARCH COMPUTER PROGRAMS

In the interest of research replication, this appendix is a compilation of the computer programs developed and used in this research. It is hoped that these programs will be very useful to future researchers who use the SPSS program package, by minimizing time spent in familiarization with SPSS control cards and computer programming.

```
  FREQUENCY  GENERATOR
#
#
        THIS PROGRAM WAS USED TO COUNT THE NUMBER OF CASES IN EACH
     ITEM CATEGORY, ROUTING IDENTIFIER (RID), AND STANDARD REPORT-
     ING DESIGNATOR (SRD) WITHIN THE INITIAL DECK OF RAW DATA FOR
     EACH AIRCRAFT STUDIED. THE INDIVIDUAL ITEM CATEGORY COUNTS
     WERE NEEDED FOR THE "SUBFILE LIST" CARD IN THE SAMPLER
     PROGRAM. THIS PROGRAM CAN ALSO BE MODIFIED TO DETERMINE
     THE FREQUENCIES OF DESIRED VARIABLES IN THE SAMPLED
     DATA FILES.
#
#
##S,R(J) :,8,16;;,16
$:IDENT:WP0354,AFIT/LSOG 80
$:SELECT:SPSS/SPSS
$:PRMFL:08,R/W,S,80A072/C135NSNS
$:PRMFL:OT,W,S,80A072/C135FREQ
RUN NAME;THESIS DATA FREQUENCIES PROGRAM
VARIABLE LIST;STOCK,NUM1 TO NUM3,MMC,NOUN1 TO NOUN5,RID,SRD,PRICE
INPUT MEDIUM;DISK
N OF CASES;2276
INPUT FORMAT;FIXED (F2.0,F2.0,F5.0,F4.0,A2,X,4A4,A3,X,A3,X,A3,X,F8.2)
PRINT FORMATS;STOCK (0)/RID (A)/SRD (A)
FREQUENCIES;GENERAL=STOCK RID SRD
READ INPUT DATA
FINISH
$:END JOB
```

```
 SORT PROGRAM
#
#
      THIS PROGRAM WAS USED TO SORT EITHER THE ENTIRE RAW DATA
    FILE OR ONLY THE SAMPLED RAW DATA FILE INTO ANY DESIRED
    SEQUENCE.
#
#
##S,R(SL) :,8,16;;,16
$:IDENT:WP0354,AFIT/LSOG 80
$:SELECT:SPSS/SPSS
$:PRMFL:15,W,S,80A072/SORTFILE,R
RUN NAME;SORT      DATA FILE
RAW OUTPUT UNIT15
VARIABLE LIST;AUR,ITEM.CAT,AMOP,PRICE
INPUT MEDIUM;CARD
N OF CASES;161
INPUT FORMAT;FIXED(F7.2,X,F2.0,X,F1.0,X,F7.2)
SORT CASES;ITEM.CAT,AUR
READ INPUT DATA
$:SELECTA:DATA.F-4
WRITE CASES;(F7.2,X,F2.0,X,F1.0,X,F7.2)
;AUR,ITEM.CAT,AMOP,PRICE
LIST CASES;CASES=161/VARIABLES=ITEM.CAT,AUR,AMOP,PRICE
PRINT FORMATS;AUR (2)/ITEM.CAT (0)/AMOP (0)/PRICE (2)
FREQUENCIES;GENERAL=AMOP ITEM.CAT
FINISH
$:END JOB
```

```
0010 SAMPLING PROGRAM
0020#
0030#
0040          THIS PROGRAM WAS USED  TO TAKE A STRATIFIED SAMPLE FROM
0050       THE INITIAL RAW DATA FILE. THE PERCENT FIGURE USED ON THE
0060       "SAMPLE" CARD WAS DETERMINED BY THE SIZE OF THE INITIAL FILE
0070       AND THE REQUIRED SAMPLE SIZE FOR THE RESEARCH.
0080#
0090#
0100##S,R(J) :,8,16;;,16
0110$:IDENY:WP0354,AFIT/LSOG 80
0120$:SELECT:SPSS/SPSS
0130$:PRMFL:08,W,S,80A072/C135NSNS,R
0140$:PRMFL:0T,W,S,80A072/SMPLC135,R
0150RUN NAME;THESIS SAMPLE GENERATOR PROGRAM
0160VARIABLE LIST;STOCK,NUM1 TO NUM3,MMC,NOUN1 TO NOUN5,RID,SRD,PRICE
0170INPUT MEDIUM;DISK
0180INPUT FORMAT;FIXED (F2.0,F2.0,F5.0,F4.0,A2,X,4A4,A3,X,A3,X,
0190;A3,X,F8.2)
0200SUBFILE LIST;SC15 (623) SC16 (373) SC17 (23) SC26 (1) SC28 (229)
0210;SC29 (79) SC30 (15) SC31 (33) SC41 (7) SC42 (2)
0220;SC43 (16) SC45 (1) SC47 (65) SC48 (50) SC53 (133)
0230;SC58 (339) SC59 (24) SC61 (32) SC62 (13) SC63 (1)
0240;SC66 (214) SC73 (3)
0250SAMPLE;0.07
0260RUN SUBFILES;EACH
0270LIST CASES;CASES=50/VARIABLES=STOCK,NUM1,NUM2,NUM3,RID,PRICE
0280PRINT FORMATS;STOCK (0)/NUM1 TO NUM3 (0)/RID (A)/PRICE (2)
0290FREQUENCIES;GENERAL=STOCK
0300FINISH
0310$:END JOB
```

```
 SKEWNESS TEST FOR THE VARIABLE "PRICE"
#
#
         THIS PROGRAM WAS USED  TO DETERMINE THE COEFFICIENT OF
     SKEWNESS IN THE "PRICE" DATA FOR EACH AIRCRAFT.
#
#
##S,R(J) :,8,16;;,16
$:IDENT:WP0354,AFIT/LSOG 80
$:SELECT:SPSS/SPSS
RUN NAME;PRICE SKEWNESS TEST
VARIABLE LIST;AUR,ITEM.CAT,AMOP,PRICE
INPUT MEDIUM;CARD
N OF CASES;152
INPUT FORMAT;FIXED(F9.2,X,F2.0,X,F1.0,X,F7.2)
MISSING VALUES;AMOP (9)
CONDESCRIPTIVE;PRICE
OPTIONS;1
STATISTICS;1,8
READ INPUT DATA
$:SELECTA:DATA135
FINISH
$:ENDJOB
```

```
 DATA PURGE AND EXTRACTION PROGRAM
#
#
         THIS PROGRAM WAS USED TO PURGE A DATA FILE OF UN
     DESIRED DATA AND REWRITE THE REMAINING,DESIRED DATA TO AN-
     OTHER DATA FILE. THIS PROGRAM WAS USED TO DEVELOP THE DATA
     FILE TO USE IN THE "ANOVA-1" PROGRAM.
#
#
 CHARACTER*1 LINE(80),VALUE*1(1),BLK/' '/
 READ(5,500)VALUE
 10 READ(7,500,END=999)LINE
 500 FORMAT(80A1)
 WRITE(8,500)(LINE(I),I=1,4),BLK,BLK,(LINE(I),I=5,14),BLK,VALUE
 GO TO 10
 999 CONTINUE
 STOP
 END
```

```
0010 PRIMARY TEST PROGRAM
0020#
0030#
0040          THIS PROGRAM WAS USED TO RUN THE SPEARMAN AND KENDALL
0050      RANK CORRELATION COEFFICIENT TESTS. THIS PROGRAM ALSO IN-
0060      CLUDES  AN ANALYSIS OF VARIANCE TEST RUN, BUT THIS WAS
0070      NOT A PART OF THE THESIS RESEARCH AND CAN BE OMITTED IF
0080      DESIRED.
0090#
0100#
0110##S,R(SL) :,8,16;;,16
0120$:IDENT:WP0354,AFIT LSG 80 T.E.FALCONER
0130$:SELECT:SPSS/SPSS
0140RUN NAME;THESIS COMPUTATIONS FOR THE C-135
0150VARIABLE LIST;AUR,ITEM.CAT,AMOP,PRICE
0160INPUT MEDIUM;CARD
0170N OF CASES;152
0180INPUT FORMAT;FIXED(F9.2,X,F2.0,X,F1.0,X,F7.2)
0190MISSING VALUES;AMOP (9)
0200NONPAR CORR;AUR WITH AMOP
0210OPTIONS;1,3,5
0220READ INPUT DATA
0230$:SELECTA:DATA135
0240NONPAR CORR;AUR WITH PRICE
0250OPTIONS;3
0260*RECODE;ITEM.CAT(15=1)(16=2)(17=3)(28=4)(29=5)(30=6)(31=7)
0270;(43=8)(47=9)(48=10)(53=11)(58=12)(61=13)(62=14)
0280;(66=15)
0290ONEWAY;AUR BY ITEM.CAT (1,15)
0300ONEWAY;AUR BY AMOP (0,5)
0310*RECODE;PRICE (LOWEST THRU 50=1)(50 THRU 100=2)(100 THRU 175=3)
0320;(175 THRU 250=4)(250 THRU 500=5)(500 THRU 1500=6)
0330;(1500 THRU 3000=7)(3000 THRU HIGHEST=8)
0340ONEWAY;AUR BY PRICE(1,8)
0350FINISH
0360$:ENDJOB
```

```
0010  ANALYSIS OF VARIANCE PROGRAM
0020#
0030#
0040          THIS PROGRAM WAS USED TO PERFORM AN ANALYSIS OF VARIANCE
0050      ON EACH OF THE  ITEM CATEGORIES COMMON TO TWO OR MORE OF THE
0060      AIRCRAFT STUDIED.
0070#
0080#
0090##S,R(SL) :,8,16;;,16
0100$:IDENT:WP0354,AFIT/LSOG 80  THESIS ANOVA PROGRAM
0110$:SELECT:SPSS/SPSS
0120RUN NAME;THESIS ANOVA PROGRAM
0130VARIABLE LIST;AUR,ITEM.CAT,ACFT
0140INPUT MEDIUM;CARD
0150N OF CASES;463
0160INPUT FORMAT;FIXED(F9.2,X,F2.0,X,F1.0)
0170VALUE LABELS;ITEM.CAT (1)IC 10 (2)IC 12 (3)IC 14 (4)IC 15 (5)IC 16
0180;(6)IC 17 (7)IC 26 (8)IC 28 (9)IC 29 (10)IC 30 (11)IC 31
0190;(12)IC 43 (13)IC 47 (14)IC 48 (15)IC 49 (16)IC 51
0200;(17)IC 52 (18)IC 53 (19)IC 58 (20)IC 59 (21)IC 61
0210;(22)IC 62 (23)IC 63 (24)IC 66 (25)IC 67 (26)IC 69
0220;(27)IC 99/ACFT (1)C-135 (3)F-4 (4)A-7
0230RECODE;ITEM.CAT (10=1)(12=2)(14=3)(15=4)(16=5)(17=6)(26=7)
0240;(28=8)(29=9)(30=10)(31=11)(43=12)(47=13)(48=14)(49=15)
0250;(51=16)(52=17)(53=18)(58=19)(59=20)(61=21)(62=22)(63=23)
0260;(66=24)(67=25)(69=26)(99=27)/ACFT (1=1)(3=2)(4=3)
0270*SELECT IF;(ITEM.CAT EQ 4)
0280ONEWAY;AUR BY ACFT (1,3)
0290OPTIONS;6
0300STATISTICS;1,2,3
0310READ INPUT DATA
0320$:SELECTA:DATABASE
0330FINISH
0340$:END JOB
0350#
0360#
0370      THE SEQUENCE "*SELECT IF","ONEWAY","OPTIONS",AND "STATISTICS"
0380   CAN BE RUN FOR ANY ITEM CATEGORY DESIRED.
```

SELECTED BIBLIOGRAPHY

AD-A087 494 AIR FORCE INST OF TECH WRIGHT-PATTERSON AFB OH SCHOOL--ETC F/G 5/1
AN ANALYSIS OF FACTORS WHICH SHOULD BE CONSIDERED IN DEVELOPING--ETC(U)
JUN 80 T E FALCONER, D J MURPHY
UNCLASSIFIED AFIT-LSSR-11-80 NL

2 OF 2
AD A
087494

END
DATE
FILMED
9-80
DTIC

A. REFERENCES CITED

1. Chao, Lincoln L. Statistics: Methods and Analyses. New York: McGraw-Hill, 1969.

2. Dickey, Galen L. Accounting and Finance Office, Headquarters Air Force Logistics Command, Wright-Patterson AFB, OH. Telephone interview. November 1979.

3. Dobler, Donald W., and Lamar Lee, Jr. Purchasing and Materials Management. New York: McGraw-Hill Book Company, 1977.

4. Emory, William C. Business Research Methods. Homewood IL: Richard D. Irwin, Inc., 1976.

5. Feeley, Charles R. Professor, Management Systems, Continuing Education Division, School of Systems and Logistics, Air Force Institute of Technology, Wright-Patterson AFB OH. Personal interview. October 1979.

6. Flint, G. S., and F. W. Jesser. "Inspection and Acceptance of Contractor-Prepared Engineering Data." Unpublished masters thesis. SLSR 4-72B, Wright-Patterson AFB OH, September 1972.

7. Furr, First Lieutenant William F., and Colonel Leon R. Reed. "The Impact of Quality Assurance on the Adequacy of Data for Air Force Procurement." Unpublished masters thesis. SLSR 21-73A, Wright-Patterson AFB OH, March 1973.

8. Griffiths, Kenneth D., and Robert F. Williams. "Transmission of Procurement Technical Requirements in the Competitive Reprocurement of Military Design Equipment." Army Procurement Research Office, Institute of Logistics Research, U.S. Army Logistics Management Center, Fort Lee VA. June 1971.

9. Hager, Captain Robert J., "A-10 Procurement Aquisition Plan: A Case Analysis." Unpublished masters thesis. GSM/SM-745-17, Wright-Patterson AFB OH, September 1974.

10. Hause, Major Dean D. and Lieutenant Colonel Amherst R. Lamb. "What Should Reprocurement Data Cost?" Unpublished masters thesis. SLSR 33-74B, Wright-Patterson AFB OH, August 1974.

11. Hutchens, Lieutenant Colonel Douglas L. "Defense Procurement and the Socioeconomic Programs." Unpublished report. Army War College, Carlisle Barracks PA, October 1974.

12. Johnson, Robert E., and James W. McKie. "Competition in the Reprocurement Process." RM-5657-PR. Santa Monica CA: The RAND Corporation, June 1968.

13. Johnson, Captain Robert L., and Captain Mark A. Southwick. "An Assessment of Relevant Decision-Making Factors Used in the Purchase of Reprocurement Data." Unpublished masters thesis. LSSR 7-79A, Wright-Patterson AFB OH, June 1979.

14. LaMartin, F. H., Jr. "Determining the Economic Value of Reprocurement Data." Defense Management Journal, Spring 1971.

15. Livesay, William. Principal Contracting Officer, Strategic Systems SPO. Wright-Patterson AFB OH. Personal interview. August 1979.

16. Neter, John, William Wasserman, and G. A. Whitmore. Applied Statistics. Boston: Allyn and Bacon, Inc. 1978.

17. Nie, Norman H., and others. Statistical Package for the Social Sciences. 2nd ed. New York: McGraw-Hill Book Company, 1975.

18. Office of Federal Procurement Policy. "A Discussion of the Application of OMB Circular No. A-109." OFPP Pamphlet Number 1. Washington: Government Printing Office, August 1976.

19. O'Neill, Lieutenant General J. W. Vice Commander, Air Force Systems Command, Andrews AFB, Washington, D.C. Letter to Lieutenant General Stewart. September 1970.

20. Peake, Lieutenant Colonel Ben F., Mr. Barrett F. Pulham, and Colonel Frank T. Watrous. "An Analysis of the Davis-Gram: Engineering Data Management." Advanced Logistics Report. Air Force Institute of Technology, Wright-Patterson AFB OH, September 1962.

21. Schwartzman, Lieutenant Colonel Larry, USAF. "Reprocurement Data Costs Can be Reduced." Air War College Report No. 5414. Maxwell AFB AL, May 1974.

22. Siegel, Sidney. Nonparametric Statistics for the Behavioral Sciences. New York: McGraw-Hill Book Company, 1956.

23. Stanley, Richard L. and others. Government Contract Law. 2nd ed. Columbus, OH: Ohio State Research Foundation, 1970.

24. Taylor, David J. Contractor Data Management Specialist, Sub-Command Data Management Office, Directorate of Materials Management, Warner Robins ALC. Telephone interview. November 1979.

25. U.S. Air Force Logistics Command. Management of Contractor Data. AFLCR 310-1. Washington: Government Printing Office, June 1971.

26. ________. Total FY Procurement Report, FY79. RCS:DD-I&L (Q) 714. Wright-Patterson AFB, OH. October, 1979.

27. U.S. Congress. Report of the Commission on Government Procurement. Washington: Government Printing Office, December 1972.

28. U.S. Department of the Air Force. Engineering Data Distribution and Control. AFR 67-28. Washington: Government Printing Office, 30 September 1977.

29. ________. Management of Contractor Data. AFR 310-1. Washington: Government Printing Office, June 1969.

30. ________. Understanding and Evaluating Technical Data Prices. Textbook LS-24. Air Force Institute of Technology, Wright-Patterson AFB OH, November 1978.

31. U.S. Department of Defense. Defense Acquisition Regulation. Washington: Government Printing Office, July 1976.

32. _______. Procurement Data Packages. MIL-STD-885B. Washington: Government Printing Office, October 1971.

33. _______. Procurement Method Coding of Replenishment Spare Parts. MIL-STD-789B. Washington: Government Printing Office, October 1966.

34. Venditti, Paul. Analysis Branch, Air Force Engineering Data Support Center, Air Force Acquisition Logistics Division, Wright-Patterson AFB, OH. Personal Interview. November 1979.

35. Wonnacott, Ronald J., and Thomas H. Wonnacott. Introductory Statistics for Business and Economics. 2nd ed. New York: John Wiley and Sons, Inc., 1977.

B. RELATED SOURCES

Byrne, Lt. Col. Richard O. Assistant Director, Support Equipment SPO, Aerospace Systems Division, Wright-Patterson AFB, OH. Personal interview, November, 1979.

Cunningham, Captain James A., USAF, Major Alan E. Olson, USAF, and Captain Donald J. Wilkins, USAF. "A Cost Benefit Analysis of Competitive versus Sole-Source Procurement of Aircraft Replenishment Spare Parts." Unpublished masters thesis. SLSR 21-74A, Wright-Patterson AFB OH, January 1974.

Fulford, Ramona. Applications Division, Product Evaluation, Engineering and Test Directorate, Air Force Acquisition Logistics Division, Wright-Patterson AFB, OH. Personal interview, November 1979.

Gordon, Bruce E. Directorate for Configuration Management, Support Equipment SPO, Aerospace Systems Division, Wright-Patterson AFB, OH. Personal interview, November 1979.

Tischer, Robert. Configurational Data Management Branch, Deputy for Acquisition Support, Aerospace Systems Division, Wright-Patterson AFB, OH. Personal interview, November 1979.

U.S. Air Force Systems Command. _Management of Contractor Data_. AFSCR 310-1. Washington: Government Printing Office, June 1971.

U.S. Department of the Air Force. _Acquisition and Management of Data for Follow-on Procurements_. AFR 310-3. Washington: Government Printing Office, 4 November 1968.

U.S. Department of Defense. _Drawings, Engineering and Associated Lists_. DOD-D-1000B. Washington: Government Printing Office, 28 October 1977.

________. _High Dollar Spare Parts Breakout Program_. AFR 57-6, Washington: Government Printing Office, March, 1969.

________. _Management of Technical Data_. DODI 5010-12. Washington: Government Printing Office, December 1968.

________. _Standardization Directory_. SD-1. Washington: Government Printing Office, April 1979.

U.S. Department of the Navy. _Presentation to NAVAIR Cruise Missile Project Office_. AIR-510SH. Washington: Government Printing Office, January 1977.

U.S. General Accounting Office. "Unnecessary Costs Incurred in the Procurement of Selected Subsystems for F-4 Type Aircraft." Washington: Government Printing Office, April 1965.

Vaillant, Normand A. "Competitive Reprocurement of DOD Mobile Electric Power Generating Sources." Defense Systems Management School Study Project Report. PLM 75-2, Defense Systems Management School, Fort Belvoir VA, November 1975.

Young, S. H. H. "Gallery of USAF Weapons," _Air Force Magazine_, May 1978.